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EASTERN IRRIGATION DISTRICT

BROOKS, ALBERTA.

Rules Governing
The Measurement
Of Water

JULY 1958

EASTERN IRRIGATION DISTRICT

Brooks, Alberta

RULES GOVERNING THE MEASUREMENT OF WATER

The flow of water will be measured and recorded as cubic feet per second and acre feet. A rate of flow of one cubic foot per second (or second foot as it is commonly called) is one cubic foot of water passing a given point in one second. Water flowing at the rate of one cubic foot per second will deliver 43,200 cubic feet in twelve hours or for all practical purposes, sufficient water to cover one acre one foot deep. This amount of water is called one acre foot and it is convenient to remember that the number of acre feet delivered in twenty-four hours is twice the number of second feet flowing.

Water is commonly measured over weirs and through orifices. By mathematics and from experiments, tables have been made up giving the flow over weirs and through orifices. For weirs and orifices properly made these tables give very accurate results and in other cases **they usually give sufficiently accurate results for practical purposes.** Weirs and orifices may be contracted or suppressed and free flow or submerged, and the flow will be somewhat different in each case.

The flow of water in an open channel or flume may also be measured by multiplying the cross-sectional area of the water by the velocity. The velocity may be measured by means of a current meter or by means of floats. The current meter method is the more accurate.

WEIR MEASUREMENT—

The depth of water over the weir can be determined by measuring from a level part of the structure down to the crest of the weir, then measuring from the same elevation to the surface of the water at a point several feet **above** the weir to avoid the lowering of the water surface near the weir. The difference between these two measurements is the head on the weir. With this quantity and the width of the weir the discharge in cubic feet per second may be obtained from TABLE 1 for standard contracted rectangular weirs.

ORIFICE MEASUREMENT—

Any undershot opening can be used as an orifice for measuring water. For accurate measurement, it must, like the weir conform to certain standards. To obtain the discharge through an orifice use TABLE 2, following the direction given there.

TABLE 1
WEIR MEASUREMENT

Head	LENGTH OF WEIR IN FEET									
Ft.	1	2	3	4	5	6	8	10	15	20
0.05	0.04	0.08	0.11	0.15	0.19	0.22	0.30	0.37	0.56	0.75
0.10	0.10	0.21	0.31	0.42	0.52	0.63	0.84	1.05	1.58	2.10
0.15	0.19	0.38	0.57	0.77	0.96	1.16	1.54	1.93	2.90	3.86
0.20	0.29	0.58	0.88	1.18	1.48	1.78	2.37	2.97	4.45	5.94
0.25	0.39	0.81	1.23	1.64	2.06	2.48	3.31	4.14	6.22	8.30
0.30	0.51	1.06	1.61	2.16	2.70	3.25	4.34	5.44	8.17	10.9
0.35	0.66	1.33	2.02	2.71	3.40	4.09	5.47	6.85	10.3	13.7
0.40	0.80	1.62	2.46	3.30	4.14	4.99	6.67	8.36	12.6	16.8
0.45	0.95	1.92	2.92	3.93	4.94	5.94	7.95	9.96	15.0	20.0
0.50	1.11	2.24	3.41	4.59	5.77	6.95	9.30	11.7	17.5	23.4
0.55	.....	2.57	3.92	5.28	6.64	8.00	10.7	13.4	20.2	27.0
0.60	.....	2.91	4.46	6.00	7.55	9.10	12.2	15.3	23.0	30.8
0.70	.....	3.74	5.58	7.53	9.48	11.4	15.3	19.2	29.0	38.7
0.80	.....	4.54	6.77	9.15	11.5	13.9	18.7	23.4	35.4	47.3
0.90	.....	5.41	8.02	10.9	13.7	16.5	22.2	27.9	42.1	56.4
1.00	.....	6.31	9.32	12.7	16.0	19.3	26.0	32.6	49.3	65.9
1.10	.....	.....	11.2	14.5	18.4	22.2	29.9	37.6	56.8	76.0
1.20	.....	.....	12.7	16.5	20.8	25.2	34.0	42.7	64.6	86.5
1.30	.....	.....	14.3	18.5	23.4	28.3	38.2	48.1	72.7	97.4
1.40	.....	.....	15.9	20.5	26.0	31.6	42.6	53.6	81.2	108.8
1.50	.....	.....	17.5	22.6	28.8	34.9	47.1	59.3	89.9	120.5
1.60	.....	.....	.....	24.8	31.5	38.3	51.8	65.2	98.9	132.6
1.70	.....	.....	.....	27.0	34.4	41.8	56.5	71.3	108.2	145.1
1.80	.....	.....	.....	29.3	37.3	45.4	61.4	77.5	117.7	157.9
1.90	.....	.....	.....	31.6	40.3	49.0	66.5	83.9	127.5	171.1
2.00	.....	.....	.....	33.9	43.3	52.7	71.6	90.4	137.5	184.6
2.20	.....	.....	.....	.....	49.5	60.4	82.1	103.9	158.2	212.5
2.40	.....	.....	.....	.....	56.0	68.3	93.1	117.9	179.8	241.7
2.60	.....	.....	.....	.....	.....	76.5	104.4	132.3	202.1	271.9
2.80	.....	.....	.....	.....	.....	84.9	116.1	147.3	225.3	303.3
3.00	.....	.....	.....	.....	.....	93.4	128.0	162.6	249.2	335.7
3.30	.....	.....	.....	.....	.....	.....	146.5	186.5	286.3	386.1
3.60	.....	.....	.....	.....	.....	.....	165.6	211.0	324.8	438.5
4.00	.....	.....	.....	.....	.....	.....	191.8	245.1	378.3	511.5

Table 1 is computed from the formula $Q=3.33 (L-0.2H) H^{3/2}$.

Q—discharge in second feet.

L—length of weir in feet.

H—head on weir in feet.

The above formula is used by the U.S. Department of Interior, Bureau of Reclamation in their Water Measurement Manual 1953. This table will give fairly accurate discharge for weirs where the head does not exceed one-third the length of the weir crest.

TABLE 2
ORIFICE MEASUREMENT

Measure the size of opening and compute its area.

Measure the head on the opening and from the table below find the corresponding coefficient. Multiply the area by the coefficient to obtain the discharge. If the water falls freely from the orifice, the head is the depth of water above the centre of the opening. If the water rises above the centre of the opening on the downstream side, the head is the difference in elevation of the water above and below the orifice.

HEAD

Feet	TENTHS									
	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
0.0	0.00	1.55	2.18	2.68	3.09	3.46	3.78	4.09	4.38	4.64
1.0	4.89	5.12	5.34	5.55	5.77	5.99	6.18	6.37	6.56	6.74
2.0	6.92	7.09	7.24	7.41	7.58	7.75	7.89	8.04	8.19	8.34
3.0	8.48	8.62	8.76	8.89	9.02	9.15	9.27	9.40	9.53	9.66
4.0	9.79	9.90	10.01	10.13	10.25	10.37	10.48	10.59	10.71	10.83
5.0	10.94	11.05	11.17	11.27	11.37	11.47	11.58	11.68	11.78	11.88
6.0	11.98	12.08	12.18	12.28	12.38	12.48	12.58	12.67	12.76	12.86
7.0	12.95	13.04	13.13	13.22	13.31	13.40	13.49	13.58	13.67	13.76
8.0	13.85	13.94	14.02	14.11	14.19	14.28	14.36	14.45	14.53	14.60
9.0	14.68	14.76	14.84	14.92	15.00	15.08	15.16	15.24	15.32	15.40
10.0	15.48	15.55	15.63	15.71	15.79	15.80	15.94	16.01	16.09	16.17

The above table is computed from the formula $Q=0.61 A\sqrt{2gH}$.

Q—discharge in second feet.

g—acceleration due to gravity.

H—Measured head on orifice in feet, being equal to the difference in elevation of the water surface on the upstream side of the orifice and the water surface on the downstream side.

A—area of the orifice in square feet.

TABLE 3

DISCHARGE IN ACRE FEET FOR VARIOUS FLOWS FOR GIVEN PERIODS OF HOURS

Hours	1	2	3	4	5	6	7	8	9	10	11	12
Sec. ft.												
1	.08	.17	.25	.33	.42	.50	.58	.67	.75	.83	.92	1.0
2	.17	.33	.50	.67	.83	1.00	1.17	1.33	1.50	1.67	1.83	2.0
3	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.0
4	.33	.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.0
5	.42	.83	1.25	1.67	2.08	2.50	2.92	3.33	3.75	4.17	4.58	5.0
6	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.0
7	.58	1.17	1.75	2.33	2.92	3.50	4.08	4.67	5.25	5.83	6.42	7.0
8	.67	1.33	2.00	2.67	3.33	4.00	4.67	5.33	6.00	6.67	7.33	8.0
9	.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.0
10	.83	1.67	2.50	3.33	4.17	5.00	5.83	6.67	7.50	8.33	9.17	10.0
11	.92	1.83	2.75	3.67	4.58	5.50	6.42	7.33	8.25	9.17	10.08	11.0
12	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.0
13	1.08	2.17	3.25	4.33	5.42	6.50	7.58	8.67	9.75	10.83	11.92	13.0
14	1.17	2.33	3.50	4.67	5.83	7.00	8.17	9.33	10.50	11.67	12.83	14.0
15	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.0
16	1.33	2.67	4.00	5.33	6.67	8.00	9.33	10.67	12.00	13.33	14.67	16.0
17	1.42	2.83	4.25	5.67	7.08	8.50	9.92	11.33	12.75	14.17	15.58	17.0
18	1.50	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.0
19	1.58	3.17	4.75	6.33	7.91	9.50	11.08	12.67	14.24	15.83	17.41	19.0
20	1.67	3.33	5.00	6.67	8.33	10.00	11.67	13.33	15.00	16.67	18.33	20.0
21	1.75	3.50	5.25	7.00	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.0
22	1.83	3.67	5.50	7.33	9.16	11.00	12.83	14.67	16.50	18.33	20.16	22.0
23	1.92	3.83	5.75	7.67	9.58	11.50	13.42	15.33	17.25	19.17	21.08	23.0
24	2.	4.	6.	8.	10.	12.	14.	16.	18.	20.	22.	24.0
25	2.08	4.17	6.25	8.33	10.41	12.50	14.58	16.67	18.75	20.83	22.91	25.0
26	2.17	4.33	6.50	8.67	10.83	13.00	15.17	17.33	19.50	21.67	23.83	26.0
27	2.25	4.50	6.75	9.00	11.25	13.50	15.75	18.00	20.25	22.50	24.75	27.0
28	2.33	4.67	7.00	9.33	11.66	14.00	16.34	18.67	21.00	23.33	25.66	28.0
29	2.42	4.83	7.25	9.67	12.08	14.50	16.92	19.33	21.75	24.17	26.58	29.0
30	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.0

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